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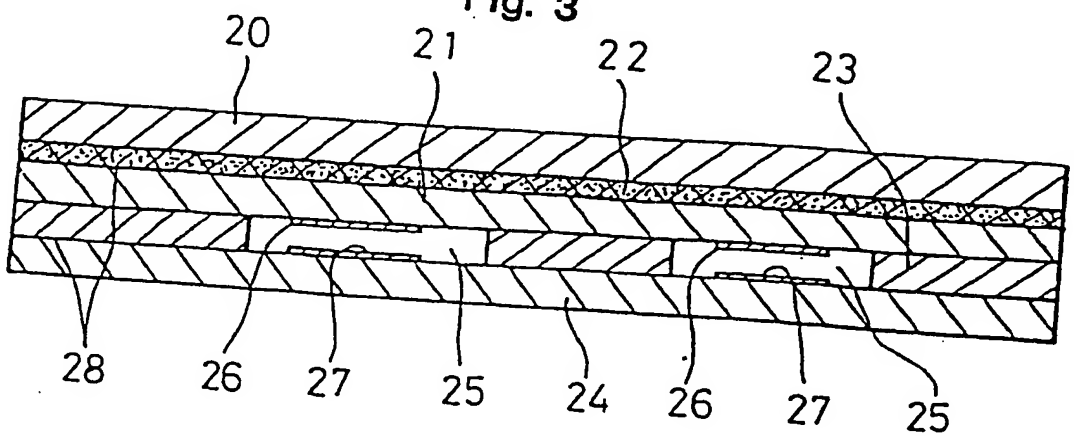
(54) Keyboard switch

(57) A membrane keyboard comprises a buffering layer 22 provided within at least one switch sheet or circuit layer whereby stress created by repeated actuation is more evenly dispersed resulting in prolonged operational life. The buffering layer 22 is preferably a material having a strong memory or restorative force such as a pressure sensitive or rubbery adhesive. The keyboard may have snap-action domes (31, Fig. 4).

Fig. 3



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SPECIFICATION
Keyboard switch

The invention relates to the field of electrical keyboards. More particularly, this invention relates to the field of membrane keyboards wherein a stable operational pressure results in prolonged operational life even over long periods of repeated actuation.

Membrane keyboards of the general type with which this invention is concerned are well known in the art. These keyboards conventionally have a pair of circuit layers, one fixed and one movable, separated by a spacer or separator layer. The circuit layers are sheets of insulating material, with circuit patterns thereon. These circuit patterns face each other and are separated by a spacer, which has apertures at the location of aligned contact elements on the fixed and movable circuit sheets. Electrical switching is effected by applying finger or other pressure to specific locations on one of the circuit sheets to move a contact on that circuit sheet through an aperture to make contact with a contact element on the other circuit sheet. The fixed and movable circuit layers and the spacer may be separate sheets of material, or any two or three of those sheets may be formed from a single sheet of material folded over in any desired fashion. Also, these keyboards often have snap action domes formed therein in order to achieve desirable tactile feedback. Keyboards of this configuration are generally formed in a laminate construction with the layers bonded together, sealed or otherwise fixed against relative lateral movement between the layers. The assembly may also include an overlay sheet with indicia of one kind or another to identify key locations and a backer plate to support the assembly.

Membrane keyboard switches as hereinabove described often develop bending in the movable switch or circuit sheets due to fatigue developed over long periods of usage. This bending leads to a loss in switch function (i.e., the upper and lower circuit patterns are in continual contact). Even when this loss in switch function is not complete, the operational pressure or actuation pressure will become less and less, thus making it more difficult to maintain the keyboard in an unactuated state as well as reducing the degree of snap action or tactile feedback if the particular keyboard has the tactile feedback feature.

In accordance with the present invention, there is provided a membrane keyboard including first electrical circuit means having a plurality of first switch contacts, second electrical circuit means having a plurality of second switch contacts corresponding to said first switch contacts, insulating spacer means between said first and second electrical circuit means, said spacer means having a plurality of openings at locations corresponding to the locations of said first and second switch contacts, and a buffering layer located within at least one of said electrical circuit means, said buffering layer comprised of a material having good restorative features.

The novel buffering layer is preferably comprised of a material having strong memory or restorative forces such as, but not limited to, a pressure sensitive adhesive or a rubbery adhesive. The keyboards of the present invention drastically improve the operational life of a switch (i.e., switch function) since the buffering layer located within the switch sheet tends to disperse the stress created when the switch is repeatedly actuated. The switch, therefore, is more economical and practical as replacement and repair costs are far reduced.

Two embodiments of the invention will now be described by way of example and with reference to the accompanying drawings, throughout which like elements are numbered alike, and in which:

Figure 1 is a cross-sectional elevation view of a membrane keyboard in accordance with the prior art.

Figure 2 is a cross-sectional elevation view of another membrane keyboard in accordance with the prior art.

Figure 3 is a cross-sectional elevation view of a membrane keyboard having a buffering layer in accordance with a first embodiment of the present invention.

Figure 4 is a cross-sectional elevation view of another embodiment of a membrane keyboard having a buffering layer in accordance with the present invention.

Referring first to Figure 1, a conventional panel membrane keyboard in accordance with the prior art is shown. The keyboard switch comprises a first circuit layer 2 and a second circuit layer 6 having circuit patterns 1 and 5 on opposed, i.e., facing surfaces. The circuit patterns 1 and 5 are made up of a plurality of electrically conductive contact points. Circuit layers 2 and 6 are separated therebetween by insulating spacer 4. Spacer 4 is provided with openings or switch cavities 3 which correspond to switch sites or contact points on circuit patterns 1 and 5. Thus, when a force is brought against flexible switch or circuit layer 6, the contact points on circuit pattern 5 are pushed through cavity 3 whereby electrical and mechanical contact is effected with the contact points on circuit pattern 1 defining a switch site. Bonding layer 7 which consists of any suitable adhesive or the like is used to laminate or bond the circuit and separator sheets together.

Referring to Figure 2, a different type of prior art membrane keyboard which includes a tactile snap action dome is shown. In Figure 2, a snap action keyboard switch includes a flexible circuit layer or switch sheet 12 having a circuit pattern 11 of contact points thereon. A lower flexible switch sheet 16 having a plurality of inverted snap action domes formed therein is separated from the switch 12 by insulating spacer 14. Spacer 14 has formed therein switch cavities or openings corresponding to the contact points on circuit pattern 11 and the contact points on circuit pattern 15 which is located along the inside base of the snap action dome of circuit layer 16. A rigid

base sheet 18 is attached to the bottom of the snap action domes of layer 16 defining open spaces 17 which permit room for the inverted domes to snap through upon actuation. The base sheet 18 also acts to support switch sheet 16 upon actuation thereof. A suitable adhesive 19 or the like acts to bond the individual constituents of the keyboard together.

As discussed, the above described prior art keyboards suffer detrimental fatigue and bending effects after repeated actuation and stressing over long periods of use. Thus, the respective opposing contact points will eventually be in constant contact as the operational pressure becomes smaller and smaller.

This problem is substantially overcome by the membrane keyboard in accordance with the embodiments of the present invention. Referring to Figure 3, a panel membrane keyboard is shown having a structure similar to the keyboard of Figure 1, but with the novel addition of a buffering layer 22. The buffering layer 22 acts to disperse the stress generated by repeated actuations and therefore greatly prolong the operational life of the keyboard of the present specification relative to the prior art.

In Figure 3, the embodiment of the keyboard of the present invention comprises a lower circuit layer 24 having a circuit pattern 27 of contact joints thereon. The upper circuit layer is comprised of two planar switch sheets 20 and 21 having sandwiched therebetween a novel buffering layer 22. An insulating spacer member 23 having a plurality of openings or switch motion cavities 25 is adhesively bonded by adhesive 28 between lower circuit layer 24 and switch sheet 21. A circuit pattern 26 of contact points is located on switch sheet 21 corresponding to an opening 25 and across from the corresponding contact points of circuit pattern 27.

Referring now to Figure 4, as noted above, the embodiments of the membrane keyboard of the present invention are quite similar to the prior art snap action keyboard of Figure 2 except for the utilization of a buffering layer within at least one of the circuit sheets which undergoes continual and damaging stress during actuation. Thus, in Figure 4, a circuit layer 31 having snap action domes formed therein is comprised of two cooperating switch sheets 31A and 31C with a buffering layer 31B laminated therebetween. On the concave portion of each dome of switch sheet 31 is a circuit pattern 30 of contact points. Upper circuit layer or switch sheet 33 is positioned above switch sheet 31 separated thereby by spacer sheet 34. Spacer sheet 34 has a plurality of openings or switch motion cavities 36. Thus, when switch sheet 33 is actuated, the circuit pattern 32 attached thereto will be brought into mechanical and electrical contact with the circuit pattern 30 whereby the dome will invert and a tactile snap action will be transmitted to the keyboard operator. As in the other Figures, adhesive 35 bonds each respective layer together.

In order to achieve the proper buffering function, buffering layers 22 and 31B are preferably comprised of a material which has a strong memory or restoring force such as a pressure sensitive adhesive, rubbery adhesive, etc. The structure of the keyboard switches in accordance with the embodiments of the present invention drastically improves the operational life of the switch operation because the buffering layer provided between the two flexible films will act to disperse the stress created by repeated actuations over long time periods.

In one representative comparison test, a membrane keyboard switch having the conventional prior art structure as shown in Figure 2 and with a switch sheet 16 comprised of a polyester film of 125 μm thickness, lost its operational life by completely losing its snap action-tactile feel after repeated actuations of between 20.000 to 30.000 times. In stark contrast, a membrane keyboard in accordance with the present invention, having a structure similar to the keyboard of Figure 4, did not lose its tactile snap action feel to any appreciable degree even after 200.000 to 300.000 repeated actuations, an unexpected improvement of tenfold over the prior art. The critical dimensions of the keyboard include polyester switch sheets 31A and 31C having a thickness of 75 μm and 30 μm, respectively, while the buffering layer was comprised of a pressure sensitive adhesive having a thickness of 50 μm.

It will be understood to those skilled in the art that the particular embodiments shown in Figures 3 and 4 are merely representative of general membrane keyboard configurations and internal construction. Accordingly, the present invention encompasses the utilization of the novel buffering layer in any membrane keyboard, regardless of the particular configuration or type of material used therein.

Claims

1. A membrane keyboard including first electrical circuit means having a plurality of first switch contacts, second electrical circuit means having a plurality of second switch contacts corresponding to said first switch contacts, insulating spacer means between said first and second electrical circuit means, said spacer means having a plurality of openings at locations corresponding to the locations of said first and second switch contacts, and a buffering layer located within at least one of said electrical circuit means, said buffering layer comprised of a material having good restorative features.

2. A keyboard as claimed in Claim 1, wherein said first electrical circuit means includes a layer of insulating material with electrically conductive means on one surface thereof facing said second electrical circuit means.

3. A keyboard as claimed in Claim 2, wherein said second electrical circuit means includes a layer of flexible insulating material with electrically conductive means on one surface thereof facing said first electrical circuit means.

4. A keyboard as claimed in Claim 3, wherein said layer of flexible insulating material comprises two cooperating sheets of insulating material.

5. A keyboard as claimed in Claim 4, wherein said buffering layer is provided between said two sheets of flexible insulating material.

6. A keyboard as claimed in Claims 4 or 5, including a plurality of snap action domes formed in said two cooperating sheets of insulating material, said electrically conductive means located on the surface of said domes.

7. A keyboard as claimed in any one of Claims 1 to 6, wherein said buffering layer is comprised of a pressure sensitive adhesive.

8. A keyboard as claimed in any one of Claims 1 to 6, wherein said buffering layer is comprised of a rubbery adhesive.

9. A membrane keyboard substantially as hereinbefore described and as illustrated in the accompanying drawings.

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